

## Observations ON SOME TENDON RUPTURES\*

BY

HARRY PLATT, M.D., M.S., F.R.C.S.

SENIOR HONORARY SURGEON, ANCOATS HOSPITAL, MANCHESTER;  
LECTURER IN ORTHOPAEDIC SURGERY, UNIVERSITY OF  
MANCHESTER

Tendon ruptures may be divided into two main groups: (1) The common rupture, produced by the sudden powerful overstretching of a muscle already in a state of contraction. Well-known examples of this type are disinsertion of the extensor tendons of the fingers, and ruptures of the tendo Achillis, rectus femoris, and ligamentum patellae. (2) This comprises a less common and more insidious form of rupture—spontaneous rupture—seen in certain tendons which occupy a bony groove. In these circumstances the rupture is determined by a pre-existing adhesion of the tendon, which gradually becomes attenuated, and ultimately snaps across in response to a comparatively trivial violence. The tendons most liable to rupture by this process of attrition are the extensor longus pollicis and the long head of the biceps. Tendon ruptures may also be classified according to the site of the tear, which may take place (a) at the musculo-tendinous junction, (b) in the tendon itself, or (c) at the point of insertion. Tears in the neighbourhood of the musculo-tendinous junction are almost invariably incomplete, and from a functional standpoint are equivalent to partial tears of the muscle belly—lesions which are usually included under the generic title "strain."

This paper is mainly concerned with the problems of early diagnosis and operative repair in some of the more important complete ruptures. The subject is illustrated by references to typical tendon ruptures selected from my own cases.

### DISINSERTION OF THE EXTENSOR TENDONS OF THE FINGERS (Mallet Finger)

Avulsion of an extensor communis digitorum tendon is produced by a sudden forced flexion of the terminal

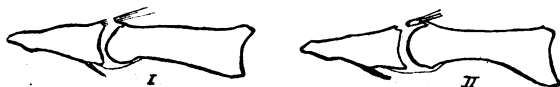


FIG. 1.—Disinsertion of extensor tendon (mallet finger). I, Tendon avulsion alone; II, Avulsion with bony fragment.

phalanx from a blow on the tip of the finger. This injury has been frequently observed in baseball players and in cricketers. It also occurs in a variety of circumstances, and often from what appears to be most inadequate violence. It happens not uncommonly to the housewife

or hospital nurse when bed-making. Usually the tendon fibres are completely detached from the margin of the distal phalanx, and may carry with them a tiny wedge-shaped flake of bone (Fig. 1).

**Clinical Picture.**—The considerable localized swelling which develops in the first twenty-four hours tends to conceal the chief diagnostic sign—the loss of the power of extending the terminal phalanx. For this reason

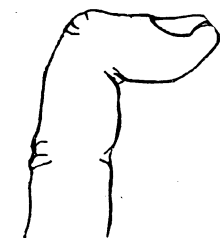


FIG. 2.—Mallet finger; the loss of the power of extending the terminal phalanx.

the true state of affairs is frequently overlooked in the early stage. Later, the dropped phalanx and the lack of extension become increasingly apparent, and constitute the typical mallet finger (Fig. 2). The swelling often disappears

slowly, and the finger continues to be painful for some weeks. In neglected cases the proximal interphalangeal joint becomes hyperextended and the finger is unsightly and awkward when used.

**Treatment.**—Excellent results follow the prompt treatment of this injury by prolonged and uninterrupted fixation of the terminal phalanx in a position of hyperextension. A period of not less than four to six weeks is required to ensure sound repair. This fact must be impressed upon the patient, who is apt to regard the accident as a trivial affair. The technique of fixation is most important. A malleable metal splint strapped to the flexor surface of the finger may be used, but offers a strong temptation to the patient to remove it at too early a date. A more effective method is to enclose the whole digit in plaster-of-Paris applied directly to the skin, with a small "sticky felt" pad inserted under the hyperextended terminal phalanx. The proximal interphalangeal joint should be held in a position of very slight flexion in order to counteract the tendency to subluxation with hyperextension (Fig. 3). On removal of the plaster at the

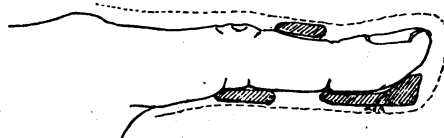


FIG. 3.—Treatment of mallet finger by fixation in plaster-of-Paris. Note position of felt pads.

end of six weeks, cautious mobilization of the digit is begun, but if the phalanx tends to drop after a few days' treatment, a further period of fixation is necessary. If seen within a few weeks from the date of the accident, a mallet finger should be treated by the method of fixation described above for the full period. Even at this late stage the tendon may become reattached, and reasonable power of active extension of the terminal joint may be regained.

Repair of the avulsed tendon by operation has been advocated and practised both in the early and in the late stage, but is regarded by most surgeons as an unsatisfactory technical procedure. A comparatively large incision encroaching on the nail bed is needed, and it is difficult to obtain a firm hold for the finest suture material in the fragile end of the tendon and the tissues around the base of the phalanx. In the considerable number of mallet fingers which I have seen and treated, operative repair has been attempted in two cases only. In both, the injury was six weeks old and the result of the operation was disappointing; there was impaired mobility at the terminal joint, with feeble power of active extension of the terminal phalanx.

### BICEPS INJURIES

#### Proximal Tendons

Rupture of the long head of the biceps is by no means an uncommon injury, but the short head appears to be immune. The long tendon may be torn across: (a) in the bicipital groove—extra-articular rupture; or (b) may be avulsed from its insertion to the upper margin of the glenoid cavity—intra-articular rupture. The rupture may follow a sudden overstretching, such as occurs during heavy lifting, or may develop insidiously when the tendon has become adherent owing to arthritic changes in the shoulder-joint. Spontaneous rupture is said to occur in elderly subjects quite apart from arthritic changes, and may be preceded by an actual dislocation of the tendon from its groove.<sup>1</sup> When divided by attrition the tendon usually acquires a secondary attachment to the humerus. The majority of spontaneous ruptures have been discovered in the dissecting room, but occasionally the condition is recognized by chance in individuals who give no history of injury.

\* Based on a lecture delivered to the Students' Medical Society, Medical School of the University of Leeds, January 27th, 1931.

**Symptoms.**—The immediate symptoms are typical of tendon ruptures in general. Owing to the depth of the tendon, localized swelling is little marked, and the absence of the tendon when the muscle comes into play may be difficult to demonstrate. Careful testing may show some diminution in the power of flexion of the elbow and supination of the forearm when compared with the opposite side. This injury, like others, is commonly overlooked

in the early stage. Later, a flabbiness of the muscle belly, with the bulge nearer the elbow than normal, is the most important sign (Fig. 4).

**Treatment.**—When a recent rupture is diagnosed in a man in the prime of life, an attempt should be made to repair the tendon by operation. In avulsion of the tendon from the supraglenoid tubercle, reattachment is likely to be impracticable; but in the bicipital groove end-to-end suture should present little difficulty. When direct repair is impossible the proximal end may be passed through the short head and fixed to the coracoid process.<sup>2</sup> In long-

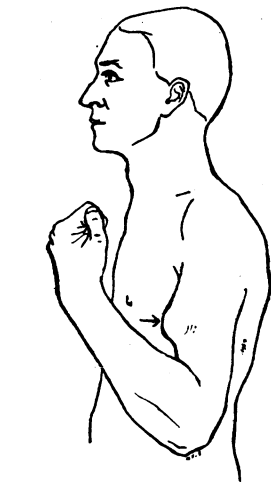


FIG. 4.—Old rupture of long head of biceps. Note bulge and retraction of muscle belly.

standing ruptures in elderly individuals operation is rarely worth while.

My series of operations for complete tendon ruptures includes no example of rupture of the long head of the biceps.

#### Distal Tendon

Rupture of the biceps tendon of insertion at the elbow is an exceedingly rare injury. I can find no record of this lesion in surgical literature. Three years ago I had the unusual experience of operating on a patient who, some forty-eight hours previously, had sustained a complete avulsion of the tendon from the bicipital tubercle.

#### CASE 1

A male, aged 44, while handling a model gear-wheel, stepped back suddenly to prevent the wheel falling on him. Soon afterwards the left elbow became very swollen and painful, and a definite weakness in the power of flexion of

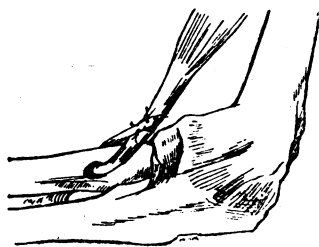


FIG. 5.—Operation for avulsion of distal tendon of biceps. Tendon reattached to neck of radius as a loop passing through bony tunnel.

An incision was made along the line of the biceps in the ante-cubital fossa and a considerable haematoma evacuated. There was no trace of the bicipital fascia, which had evidently been completely torn across. The tendon was discovered lying curled up like a snake, with its free end slightly oedematous and rounded. The neck of the radius was then exposed, after retracting the brachial artery and median nerve to the inner side and the musculo-spiral nerve to the outer side. The bicipital tubercle was seen to be quite bare; there remained no trace of any fibres of insertion to which the avulsed tendon could be reattached. The tendon was therefore passed through a tunnel drilled transversely in

the neck of the radius, and on emergence was sutured to itself under fair tension, with the elbow in the position of right-angle flexion (Fig. 5). After closure of the wound, the arm was fixed in this position in a light plaster-of-Paris cast. Faradic stimulation of the biceps was begun ten days later, and at the end of a fortnight gentle active movements of the elbow were encouraged. Six months later the biceps muscle was acting with full power; a strong tendon could be felt in the ante-cubital fossa, and there was a complete range of movement at the elbow-joint.

#### RUPTURE OF THE EXTENSOR LONGUS POLLICIS

Rupture of the long extensor of the thumb in the radial groove (Fig. 6) is the best known of the spontaneous tendon ruptures, and numerous examples have been recorded in the surgical literature of various countries.<sup>3</sup> The condition occurs either as an isolated lesion or as a sequel of fracture of the lower end of the radius. The former type was probably first recognized and described

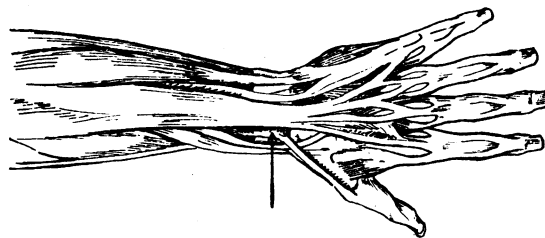


FIG. 6.—Extensor longus pollicis. Site of rupture in bony groove.

many years ago by German military surgeons under the title "kettle-drummer's palsy" (von Zander). In the drummer the rupture has most frequently been seen in the left hand, and is generally preceded by a painful tenosynovitis caused by the prolonged use of the drumstick. When the lesion is associated with fracture, the tendon rupture takes place some weeks after the occurrence of the bony injury. The sequence is fracture, distortion of the bony groove, adherence of the tendon, gradual attrition, rupture. Seven cases have come under my personal observation during the past three years; one was that of a weaver in whom the rupture followed an occupational tenosynovitis; the remaining six cases were all associated with fracture of the lower end of the radius. In four cases, the tendon was repaired by operation; three patients declined to submit to operation.

#### CASE 2

Bricklayer, aged 23. Fracture of the lower end of the right radius with very little displacement; returned to work seven weeks later; worked for five weeks; gave up work owing to weakness in the thumb and inability to grasp bricks. When examined nine months later, extensor longus pollicis out of action. The operation of end-to-end suture was performed. Tendon in groove represented by a few strands of scar tissue. Ends trimmed and approximated under tension; suture reinforced by a fine strip of fascia lata. Repaired tendon not replaced in the groove; oblique course not preserved. The result was fair function, but it was marred by late stretching of repaired tendon, and by loss of obliquity.

#### CASE 3

Male, aged 50. Colles's fracture with very slight displacement; five weeks later he felt something snap in his thumb while putting on a glove. Examined twenty-four hours later, extensor longus pollicis tendon out of action. Suture was done ten days after rupture. No trace of tendon in groove; considerable retraction of ends. End-to-end suture; oblique course preserved. Perfect restoration of function resulted.

#### CASE 4

Male, aged 18. Subperiosteal fracture of lower end of radius with no displacement; perfect function seen after three weeks; worked for eight weeks, then noticed inability

to straighten the end of the thumb. Examined eleven weeks after rupture, extensor longus pollicis tendon out of action. Tendon in groove intact and not adherent; below groove, tendon showed a fusiform expansion, and was obviously elongated. Resection of fusiform swelling; end-to-end suture. Function was perfectly restored.

Probably this was an incomplete rupture which had healed, leaving an elongated tendon.

#### CASE 5

Colles's fracture in a female, aged 19, united with considerable deformity; fair functional result. One year later patient found herself unable to straighten the end joint of the thumb. No history of any fresh injury or of preceding discomfort. Examination showed extensor longus pollicis tendon out of action. At operation there was no trace of tendon in groove, which was much distorted; owing to size of the gap, end-to-end suture impracticable. Gap closed by free tendon graft (from extensor longus digitorum of the foot); oblique course preserved by passing tendon through fascial pulley (Fig. 7). Perfect result.

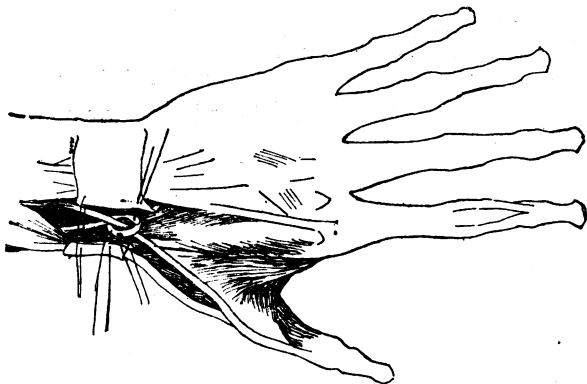


FIG. 7.—Repair of rupture of extensor longus pollicis. Shows method of preserving obliquity of tendon by pulley constructed from fascia.

**Diagnosis.**—The diagnosis of rupture of the extensor longus pollicis rests on two signs: (1) inability to extend the dropped terminal phalanx of the thumb against resistance; (2) absence of the subcutaneous bowstring normally formed by the tendon when the thumb is fully extended. It is sometimes possible to feel the distal part of the divided tendon and to demonstrate its unusual laxity. The loss of function may also be demonstrated by stimulating the muscle belly by the faradic current. When the distal end acquires a stout adherence to the lower end of the radial groove, dropping of the proximal phalanx is often inconspicuous.

**Treatment.**—Repair by operation should be undertaken without delay. In a recent rupture, before wide retraction of the ends has taken place, direct suture is usually feasible. In order to secure perfect function the oblique course of the tendon should be preserved, but if the bony groove is much distorted, or the localized scarring is considerable, the original bed is unsuitable for a newly repaired tendon. The construction of a pulley from a free fascial graft, as used successfully in Case 5, is a method of overcoming this difficulty (Fig. 7). In older ruptures, where a considerable gap remains to be closed, direct suture is also the method of choice, but if impracticable, a free tendon graft should be inserted. Alternatively, the distal end of the tendon may be attached to one of the short thumb tendons, a procedure which cannot restore independent action in the long extensor, but which prevents the dropping of the terminal phalanx. After any form of operative repair the thumb should be supported in full extension for three weeks. Early function should be encouraged from the seventh day onwards by faradic stimulation of the muscle belly in the forearm.

#### RUPTURE OF FLEXOR PROFUNDUS DIGITORUM

My series contains a single example of a rare tendon injury—rupture of one of the long flexor tendons of the fingers.

#### CASE 6

Rupture of flexor profundus digitorum of left ring finger in a male, aged 16. Swelling in palm of left hand after playing Rugby football. Played two or three games during the next few weeks without much difficulty, but was aware that he could not bend the end joint of the ring finger. Examination two months after "injury" disclosed a localized swelling in the left palm in long axis of metacarpal of ring finger; complete inability to flex terminal phalanx of this digit. The common flexor sheath of the ring finger was opened in the palm; proximal end of ruptured profundus tendon swollen and rounded; no trace of distal end. Skin incision prolonged along finger; distal portion of tendon identified, consisting of thin strand extending from site of bifurcation of the sublimis tendon to point of insertion; obviously unsuitable for use in direct repair. Gap could not be closed by direct suture. Free tendon graft from palmaris longus sutured to proximal end of profundus tendon, carried through normal split in the sublimis, and sutured to the remains of profundus tendon in the region of its insertion. After-treatment consisted of faradic stimulation of the muscle belly in forearm begun on the fifth day. The result was restoration of fair power of flexion of the terminal phalanx.

This case illustrates (a) the considerable retraction of the proximal end which occurs in rupture of a flexor tendon; (b) the rapid degeneration of the distal end within a few weeks after the rupture; (c) the restoration of continuity by a free tendon graft.

#### TENDO ACHILLIS

Rupture of the tendo Achillis is essentially an injury of middle life, and may be produced in many diverse circumstances. The clinical picture has been familiar for centuries, and accurate descriptions can be found in the writings of Ambroise Paré, J. L. Petit (1721), and the Edinburgh anatomist and surgeon Monro (1781), who, like John Hunter, was himself a victim of this accident.

Although incomplete ruptures of the Achilles tendon occur, they are admittedly rare, except in the region of the musculo-tendinous junction, where the lesion is popularly but incorrectly described as rupture of the plantaris. It is believed that an incomplete tear in the lower part of the Achilles tendon may be converted into a complete rupture by a second injury a few days or weeks later—the rupture "en deux temps" of the French writers Quénu and Stoianovitch.<sup>4</sup> In the ordinary complete rupture the tendon gives way through its narrowest part about one and a half inches above its insertion. The rupture may be represented by a clean transverse section, or the tendon bundles may break at different levels, leaving ragged and "skein-like" ends. The sheath may be uninjured, but plantaris remains intact. More frequently there is a localized

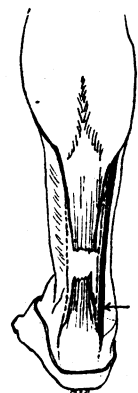


FIG. 8.—Complete rupture of tendo Achillis. Note that plantaris remains intact.

hiatus on the posterior aspect. Immediately following the rupture the proximal end retracts owing to the pull of the powerful calf muscle. The interior of the sheath rapidly fills with blood, and the walls of the sheath become oedematous. It is a striking fact that the plantaris tendon almost invariably remains intact (Fig. 8).

**Clinical Picture.**—At the moment of rupture the patient experiences a sudden pain, sharp and stabbing, as if from a direct blow over the tendon. The immediate disability is usually considerable, and in a short time the injured region becomes swollen and tender. If a complete

rupture of the tendo Achillis is overlooked, and the unfortunate patient is encouraged to walk about, the whole foot becomes swollen and painful. At a later stage the sheath and the swollen proximal and distal ends of the tendon are often exquisitely tender. In untreated ruptures the thickened sheath becomes adherent to the tendon ends, and acts as a feeble bond of union. The calf muscle remains elongated, and the power of plantar flexion is permanently impaired.

**Diagnosis.**—The diagnosis of complete rupture of the tendo Achillis is not always a simple matter, and particularly when the leg is

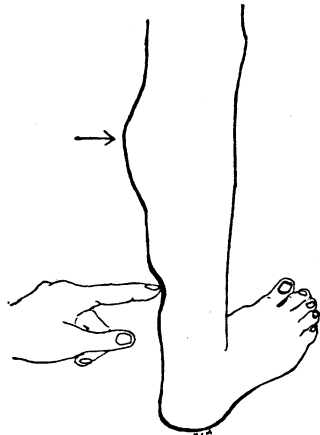


FIG. 9.—Complete rupture of tendo Achillis. Note (a) gap; (b) high retraction of calf; (c) abnormal range of dorsiflexion at ankle-joint.

examined twenty-four hours after the accident. The intact plantaris tendon, and the distended and oedematous sheath, mask the gap and give an impression of unbroken continuity. It is thus not surprising that complete rupture of the tendo Achillis frequently escapes diagnosis. A careful scrutiny, however, should establish the existence of the following signs: (1) A gap into which at least one finger can be introduced, and which is increased by dorsiflexing the foot. (2) High retraction of the calf belly. (3) An abnormal range of passive dorsiflexion when compared with the uninjured side (Fig. 9). This is perhaps the most important diagnostic sign of all; it is absent in partial ruptures. (4) The loss of true gastrocnemius and soleus action in plantar flexion, a movement still carried out with fair vigour by a combination of the peroneus longus, tibialis posticus, and long flexors of the toes. The break in continuity in the tendon may also be demonstrated in a lateral radiogram taken with a soft tube, a useful method of examination which should not be omitted in doubtful cases.

**Treatment.**—Recent complete ruptures should be repaired by operation as soon as possible. After opening the tendon sheath and evacuating the contained clot traction is applied to the proximal end of the divided tendon. With the calf fully relaxed by plantar-flexing the ankle and flexing the knee, the ends can be approximated without undue tension. Contact is best maintained by a stout transfixion suture of kangaroo tendon inserted transversely well above and below the line of rupture. Additional security is provided by a number of catgut stitches of lesser calibre. Absorbable suture material is as a rule preferable, and more especially when there is much induration of the tendon ends. In the sliding tears with ragged bundles there is a tendency for the sutures to cut out. In such circumstances the site of union should be reinforced by a living suture fashioned from a strip of fascia lata. The sheath should be carefully restored whenever practicable. At the completion of the operation the leg is fixed in plaster-of-Paris, with the foot in full plantar flexion and the knee in flexion. Three weeks later the foot is brought gently to the right-angle position, and a plaster applied, in which the patient is allowed to walk. Six weeks from the time of the operation the plaster is removed, and walking allowed in a slipper with an elevated heel. Massage, faradic stimulation of the calf muscle, and graduated exercises follow, with re-education in the normal heel-and-toe gait. The ultimate results of suture of the tendo Achillis in

recent ruptures are eminently satisfactory. If for any reason operation is contraindicated, the foot should be fixed in full equinus for six weeks in the hope that a fibrous tissue bridge may form in the gap.

In old, neglected ruptures seen a few weeks or even months after the injury, the great retraction of the calf, the fibrous infiltration of the tendon ends—which now require trimming—and the adhesion of the sheath, are factors which enhance the difficulty of operative repair. In order to obtain even bare contact of the divided ends it is necessary to mobilize the proximal part of the tendon and gastrocnemius belly for a considerable distance, and to apply powerful traction with the knee flexed. In my judgement, reinforcement of the suture line by a strong fascial strip is essential in all late repairs. The plantaris tendon may also be used as a reinforcement (see Case 15). In exceptional ruptures where the gap cannot be closed by direct suture, either the turning down of a flap or the insertion of a free tendon graft must be contemplated; procedures which restore continuity at the expense of a permanently lengthened calf. Of the two alternatives, in my opinion, the graft is to be preferred, as the fibrosed avascular proximal end of the Achilles tendon is most unsuitable material for a living bridge. If a graft is used it may be wise to strengthen the power of plantar flexion by transplanting the peroneus longus and tibialis posticus to the os calcis at the site of the Achilles insertion (Case 9).

#### Case Records of Complete Ruptures of Tendo Achillis

Case	Sex, Age, etc.	Accident	Operation	Result
7	F., 43 Left	Tennis. Undiagnosed for several weeks	Tendon grafting (3 months after injury). Plantaris intact. Large gap in Achilles impossible to close by direct suture. Free tendon graft inserted (semitendinosus).	Good function; calf somewhat elongated
8	M., 42 Left	Tennis	Suture (24 hours after injury). Plantaris intact. Achilles ends ragged	Perfect function
9	F., 26 Left	Jumping and vaulting horse. Undiagnosed for 6 months	Tendon grafting + transplantation peroneus longus and tibialis posticus to os calcis (6 months after injury). Plantaris intact	Perfect function; plays all games
10	M., 45 Left	Badminton	Suture, with fascial reinforcement (5 days after injury). Plantaris intact	Perfect function
11	M., 49 Right	Badminton	Suture (2 days after injury); fascial reinforcement. Plantaris intact	Perfect function
12	M., 40 Left	Tripped over a stone	Suture; fascial reinforcement (5 weeks after injury). Plantaris intact	Perfect function
13	M., 60 Left	Turning round suddenly, twisted left ankle	Suture (2 weeks after injury). Plantaris intact	Perfect function
14	M., 58 Left	Slipped on deck of liner	Suture (9 weeks after injury); reinforcement by flap and fascial strip. Plantaris intact	Perfect function; has since climbed Matterhorn
15	M., 54 Right	Caught foot in a hole in the floor. Undiagnosed for some weeks	Suture (9 weeks after injury); reinforcement by plantaris	Perfect function
16	M., 38 Right	1. High diving; pain back of calf 2. Nine weeks later, strained right ankle; felt similar pain	Suture (12 weeks after injury); fascial reinforcement. Plantaris intact	Excellent function six months later; further improvement anticipated
17	M., 41 Left	1. Jumping on sandy beach; (?) rupture of tendo Achillis 2. Four weeks later walking up steps felt something snap above heel	Suture 6 weeks after injury. Plantaris intact	Perfect function

#### RECTUS FEMORIS

The strong rectus femoris tendon may be torn across during a powerful muscular contraction as an alternative to the more familiar injury, fracture of the patella. The mass of tendon fibres are usually avulsed from the upper lip and anterior surface of the patella, but a slender deep

strip may remain intact. The suprapatellar pouch of the knee-joint is torn and a haemarthrosis develops. The victims of this injury are almost invariably past middle age, and the clinical picture is typical of tendon ruptures in general. The gap in the line of the tendon is usually obvious, and in spite of the integrity of the vastus externus and internus, the power of active extension of the knee is completely lost. My own operative experience of this injury comprises three cases only—in vigorous men 72, 58, and 68 years of age respectively—and in each instance the result was complete restoration of function.

#### Cases of Rupture of Rectus Femoris

Case	Sex, Age, etc.	Accident	Operation	After-treatment
18	M., 72 Left	Slipped and fell on icy footpath	Suture (1 week after injury); slender deep strip intact	Faradic stimulation of quadriceps after tenth day. Active mobilization after 3 weeks
19	M., 58 Left	Slipped with leg underneath him	Suture (3 days after injury)	As above
20	M., 68 Left	Slipped while walking downstairs	Suture (4 days after injury); deep strip intact	As above

#### LIGAMENTUM PATELLAE

Rupture of the ligamentum patellae is the least common injury of the knee extensor mechanism. The upward retraction of the patella, the absence of the ligament, and the loss of power of extension of the knee are the obvious diagnostic signs. In a recent rupture direct suture should always be feasible. In a long-standing untreated rupture, where there is marked retraction of the quadriceps and patella, and the ligament is represented by an attenuated fibrous band, the construction of a new ligament is necessary. The technique of such an atypical procedure is illustrated in the two examples of this injury in my series.

##### CASE 21

Male, aged 50. Complete rupture of left ligamentum patellae, sustained six months previously. Operation was done to reconstruct ligamentum patellae by free fascial graft. Tibial crest in the region of the tubercle drilled transversely; long strip of fascia lata removed from the thigh, carried through the drill hole, and free ends sutured to each other and remains of ligamentous tissue at apex of patella. The after-treatment consisted of fixation on Thomas's splint for three weeks; faradic stimulation of the quadriceps muscle after the tenth day; cautious mobilization of the knee-joint after four weeks. Four months later the patient could actively extend the knee from the position of 60 degrees flexion, and the reconstructed ligament could be felt as a stout band. Patient was lost sight of for some months; when examined nine months from the time of operation it was discovered that the ligament had stretched and the power of extension had become feeble. Further operative treatment advised, but refused.

##### CASE 22

Rupture of left ligamentum patellae in a male, aged 44, eight weeks previously. Notes of operation: Free ends of (a) long strip of fascia lata, and (b) semitendinosus tendon (both still attached at their lower ends) passed in opposite directions through tunnel in apex of patella. Fascia lata strip long enough to be brought down to tibial tubercle and carried through tunnel in tibial crest at this level, where it was stitched to itself, to neighbouring periosteum, and remains of the ligamentum patellae. Semitendinosus tendon not long enough to reach tibial tubercle; free end stitched to the fascia lata strip between the patella and tubercle. It was noted at the operation that there was no trace of either the ligamentum patellae or the fascial expansion from the vasti muscles; the lower end of the femur was covered by a thin capsule only. After-treatment was carried out by fixation on Thomas's splint; faradic stimulation of the

quadriceps after the tenth day; walking allowed after the third week in a posterior shell; active mobilization of the knee begun after the fourth week. The result was a strong tendon, but permanent elongation of extensor mechanism; fair power of active extension, but range of flexion remains limited to 60 degrees.

I am indebted to my colleague Dr. Margaret H. Morley for the accompanying illustrations.

#### REFERENCES

- <sup>1</sup> Meyer, A. W.: *Arch. of Surg.*, xvii, No. 3.
- <sup>2</sup> Gilcreest, E. L.: *Journ. Amer. Med. Assoc.*, June 13th, 1925.
- <sup>3</sup> Ramsay Hunt: *Journ. Amer. Med. Assoc.*, 1915, lxiv; Scudder and Paul: *Boston Med. and Surg. Journ.*, 1903; Levy, W.: *Zentralbl. f. Chir.*, January 7th, 1922; Dykes, S. N.: *British Medical Journal*, March 11th, 1922; Hauck, G.: *Arch. f. klin. Chir.*, 1923, cxxiv, 89; Dujarier and Bourguigan: *Bull. et Mém. Soc. Nat. de Chir.*, April 9th, 1927. (These are merely a selection from the voluminous literature on rupture of the extensor longus pollicis.)
- <sup>4</sup> Quénu and Stoianovitch: *Rev. de Chir.*, 1929, xlviii, 10.

## MINERS' NYSTAGMUS

BY

W. E. COOKE, M.D., F.R.C.P.Ed., D.P.H.

DIRECTOR OF THE PATHOLOGICAL DEPARTMENT, WIGAN INFIRMARY

Miners' nystagmus is an occupational disease peculiar to workers in coal mines in which the illumination is deficient. The nystagmus is fine and rapid, rotatory, pendular, and vertical. Violent rotatory movements of the eyeballs may be present and continuous with the eyes at rest, if such a state be possible, while in other cases the nystagmus is latent, is difficult to elicit, and is transitory. The movements are equal in frequency and range in both eyes, and are most commonly actuated by looking upwards with the head fixed.

The generally accepted theory of causation is that in dim light the retina functions by means of the rods and not the cones. There are no rods at the fovea centralis, so that in a bad light the eye must move 15 degrees or more from its midpoint to obtain the image of an object. Irregular reflections from the uneven coal surface and the constant maximum stress on accommodation contribute to the general eyestrain.

In some respects miners' nystagmus resembles the occupational palsies. It manifests itself only after a long period of work at the coal face, just as the craft palsies affect the expert and not the novice, and there is loss of volitional control of some of the extrinsic eye muscles. The condition is often accompanied by spasm of the levator palpebrae muscle, and by blepharospasm, and the frequent presence of neuroses further illustrates the resemblance. In the occupational palsies, however, the spasm affects muscles directly concerned; in miners' nystagmus the muscles affected by spasm are some distance away from those directly implicated, and the spasm bears no relationship to the severity of the condition. In fact, severe blepharospasm is often present when nystagmus cannot be elicited by any means, and violent nystagmus may be present without blepharospasm. The spasm in this respect resembles a reflex spasm, and in certain cases a psychasthenic tic.

There are also several points of resemblance between miners' nystagmus and tetany. The constant positional changes due to the dim light lead to exhaustion and hyperexcitability of the myoneural apparatus of the extrinsic eye muscles. This corresponds to the local tetanies from fatigue. Like tetany, nystagmus may be latent, and become apparent only when tension is placed upon the muscles by the patient looking upwards with the head flexed and fixed. In many cases nystagmus is exhibited only when the patient has been in a stooping position for some time and then looks upwards, with the